A CLOSER LOOK

…at
Best Management Practice,
Stormwater Treatment &
Supplemental Technology Research

Stormwater Treatment Areas decrease phosphorus in agricultural stormwater runoff. The retained phosphorus remains in the constructed wetlands as peat, the natural "soil" of the Everglades.

The Everglades is at risk of changing forever

The Everglades is North America's largest wetland. As a unique ecological system and the only subtropical wilderness in the United States, it is an extraordinary place. Hidden among its savannas, hammocks and forests is an amazing biodiversity. The area is a refuge to 67 plant and animal species declared endangered or threatened by the state of Florida and the federal government. Urban areas next to this rich ecosystem depend on it for drinking water, flood control and long-term economic sustainability. The Everglades is one of only three sites on earth declared as an International Biosphere Reserve, a World Heritage Site and a Wetland of International Importance.

The Everglades is a low-nutrient wetland that has formed over several thousand years from the limited nutrients available in rain and surface water. Today, Lake Okeechobee water and stormwater pumped from agricultural fields south of the lake carry extra phosphorus to the Everglades. Construction of canals and water control structures has changed the quantity and timing of water flows. Plants that thrive in a low-nutrient environment and the animals that depend on them to live often are displaced by other plants and animals that flourish in the higher nutrient conditions and altered hydropattern. Because of these alterations, the character of the Everglades is changing unacceptably.

The removal of excess phosphorus

In review…

- Excess phosphorus in the Everglades causes undesirable environmental changes.
- Best Management Practices are implemented on farms by growers to decrease phosphorus in stormwater before it is discharged to the Stormwater Treatment Areas.
- Stormwater Treatment Areas are constructed wetlands that will decrease phosphorus in agricultural stormwater before it is discharged to the Everglades.
- Supplemental technologies will be applied in conjunction with Stormwater Treatment Areas to further remove phosphorus to acceptable levels.

from Everglades Agricultural Area (EAA) stormwater before it discharges to the Everglades is an important goal of the District's Everglades program. The implementation of Best Management Practices (BMPs) on farms and the construction of 70 square miles of Stormwater Treatment Areas (STAs) to decrease phosphorus before the water flows into the Everglades is Phase I of the solution. But alone, the BMPs and STAs may not be able to reach the low phosphorus levels required by environmental restoration goals. The District may incorporate supplemental treatment during Phase II to meet the levels of phosphorus removal required for a successful environmental restoration effort.

List of Supplemental Technologies Under Investigation

- ✔ Chemical Treatment/Direct Filtration
- ✔ Chemical Treatment/High-Rate Sedimentation
- ✔ Chemical Treatment/Dissolved-Air Flotation
- ✔ Microfiltration
- ✔ Low-Intensity Chemical Dosing
- ✔ Managed Wetlands
- ✔ Submerged Aquatic Vegetation (SAV)/Limerock
- ✔ Periphyton-based STAs (PSTAs)

Preliminary studies have identified and recommended several supplemental water treatment strategies for further research that show good potential for removing phosphorus. The scientific testing and evaluation of those methods, which include both conventional and new ideas, started in 1996 and will continue until 2003. Beyond the removal of phosphorus, supplemental technologies must not reduce the water's many beneficial qualities.

Best Management Practices lower the amount of phosphorus

The amount of total phosphorus in runoff from the EAA to the Everglades has shown an annual reduction of 55 percent over the three-year period through April of 1998 because of implementation of on-farm BMPs. BMP research to decrease phosphorus in agricultural stormwater runoff was conducted in the EAA by the District between 1986 and 1991. Since that time, BMP research has continued by numerous entities including the District, and collaborative efforts between state and federal agencies as well as the agricultural industries and individual growers. The continuing goals of this research are to further refine existing BMPs and identify others to maximize phosphorus reduction.

Constructed wetlands contain thriving plant communities that decrease phosphorus in agricultural stormwater. They also provide food and shelter for many types of amphibians, reptiles, birds and fish.

Stormwater Treatment Areas use plants to lower the levels of phosphorus

STAs are constructed wetlands that remove and store nutrients through plant growth and the accumulation of dead plant material in a layer of peat. The District will build about 45,000 acres of constructed wetlands before the end of 2003. The Everglades Nutrient Removal Project (ENR) is the District's 3,800-acre prototype STA. Research is under way at the ENR to help staff understand better how to operate constructed wetlands to optimize their phosphorus removal. During the first 32 months of operation, from August 1994 through March 1997, the ENR removed more than 108,000 pounds of phosphorus from EAA stormwater, and its discharge had an average total phosphorus concentration of about 22 parts per

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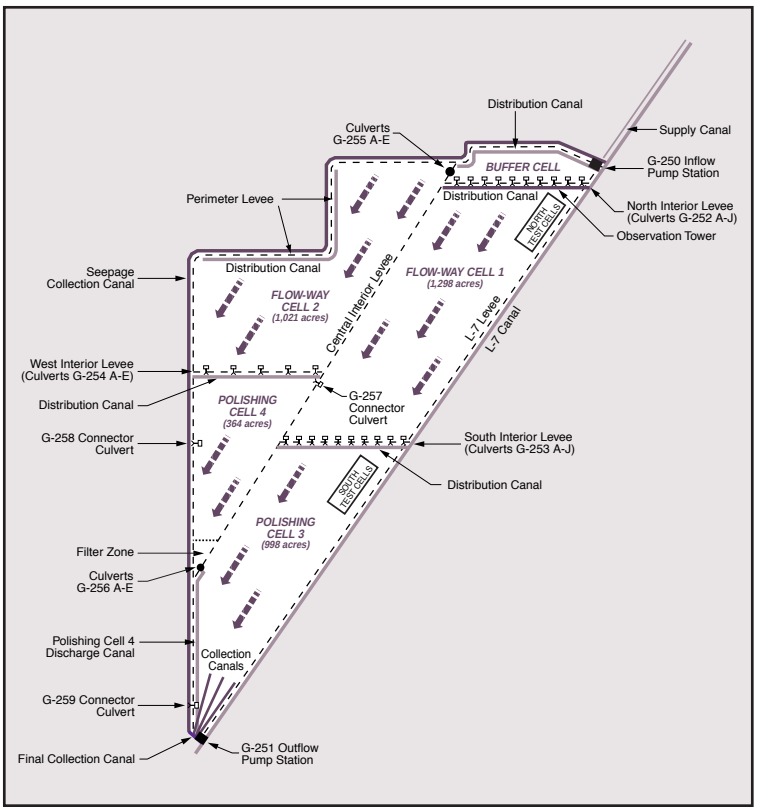

This schematic design of the Everglades Nutrient Removal (ENR) Project illustrates the flow of water and water control structures.

billion (ppb).

Much of the District's research on optimizing STA operation for phosphorus removal and several of the supplemental technology demonstration projects will be conducted in the ENR test cells. The test cells are small, shallow impoundments, each approximately 0.5 acre in size, that are arranged into banks of 15 cells each; one bank is located within Flow-way Cell 1 and another within Polishing Cell 3. Each test cell was built with a plastic liner that lies under the bottom sediments to isolate the cell from adjacent test cells and the surrounding flow-way or polishing cell. District researchers will conduct replicated experiments in the test cells that would not be possible to carry out in the much larger ENR.

Here is a view of the ENR test cell where STA optimization and supplemental technology research will be conducted.

Research on STA optimization will focus on studying the effect that varying water inflow rate and depth has on treatment efficiency. These experiments will give the District a better understanding of what set of operating conditions promote the greatest phosphorus removal and, conversely, what operating conditions result in unacceptable performance. This information is critical to developing an operational plan for the STAs.

The District is investigating a number of supplemental technologies to work in conjunction with STAs to remove phosphorus to even lower levels. The BMPs and STAs, in combination with effective supplemental technologies, may be required to reduce phosphorus in agricultural stormwater to 10 ppb – a very low level. The technologies described below have been selected for a closer look.

Chemical treatment uses iron or aluminum salts in combination with a solids separation step to remove dissolved and particulate phosphorus. This method, which is similar to drinking water treatment, could be used to treat either STA inflow or outflow water, and because the process produces solid precipitates, finding a practical disposal method is desirable. Solids separation can be accomplished by several methods including sedimentation, direct filtration, microfiltration with membranes and dissolved air flotation. The District's ENR-based pilot facilities are providing the information needed to make an informed decision about this technology and its value for the environment.

Managed wetlands are a variation on this theme that couples chemical treatment in conjunction with constructed wetland treatment to make the most of both technologies. Low-intensity chemical dosing with metal salts at the inflow of an STA could precipitate

PARTNERSHIPS IN RESEARCH

- EAA - Environmental Protection District
- Florida Department of Agriculture and Community Services
- Florida Department of Environmental Protection
- University of Florida IFAS
- U.S. Environmental Protection Agency
- U.S. Army Corps of Engineers

some phosphorus and enhance the performance of STAs. Chemicals would be added to the stormwater as it enters the STA to produce a precipitate that accumulates in the peat layer and does not leave the STA. Studies based in the ENR are evaluating how this treatment strategy can be applied to help meet water quality goals.

> All of the supplemental technology research projects will generate data and information about each technology's operation and capability to remove phosphorus.

Submerged aquatic vegetation/limerock is a two-stage treatment method that can remove phosphorus from stormwater. First, the submerged aquatic vegetation raises the water's pH before it is discharged onto a crushed limerock bed. At the higher pH, phosphorus is adsorbed to the limerock's surface and removed from the water stream. An ENR-based, pilot project will reveal the treatment potential of this technology.

Periphyton-based wetlands (PSTAs) are a special type of engineered wetland that is managed to promote the growth of periphyton (attached algae) to remove phosphorus from stormwater. In principle, periphyton wetlands are similar to other constructed wetlands except the vegetation is mostly microscopic algae. Phosphorus will be bound up in newly formed soil in addition to that which is used by the algae to grow.

All of the supplemental technology research projects will generate data and information about each technology's operation and capability to remove phosphorus. Funding and staffing of these research projects comes from the District, the EAA - Environmental Protection District, the Florida Department of Environmental Protection and other entities interested in developing the most cost-effective phosphorus removal technologies possible. District scientists will compare the different treatment strategies and evaluate their merits based on the benefit to the environment, cost, vulnerability to environmental conditions and the effort required for operation.

Researchers perform laboratory experiments on agricultural stormwaters to learn more about their chemical properties.

What's ahead…

- Continued research and demonstration projects to identify supplemental technologies for phosphorus removal.
- Research to optimize operation of STAs for maximum phosphorus retention.
- Comparison of all research data to learn which treatment strategies can best meet legislated water quality goals.
- Preliminary design of the best supplemental technologies for use in conjunction with STAs.
- Data analysis and research to optimize Best Management Practices in the Everglades Agricultural Area and the C-139 Basin.

For more information on Supplemental Technology Research, please contact the SFWMD at (561) 686-8800.

For news on other SFWMD research projects, please see the following *Closer Look* publications:

- An Overview of Current SFWMD Research
- Estuary Research
- Everglades Research
- Kissimmee River Research
- Lake Okeechobee Research
- Southern Everglades and Florida Bay Research